Overview of Mercury Magnetospheric Orbiter (MMO) for BepiColombo
Go Murakami1, Hajime Hayakawa1, Masaki Fujimoto1, and BepiColombo project team
1Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (3-1-1 Yoshinodai, Chuo, Sagamihara, Kanagawa 252-5210, Japan, E-mail: go@stp.isas.jaxa.jp)

Introduction: Mercury has the weak planetary magnetic field stands against the intense solar wind in the close proximity of the Sun. Mercury’s plasma environment is quite different in the parameters from the well-studied terrestrial magnetosphere. Thus Mercury’s magnetosphere is one of the best targets to study planetary environments. In addition, recently many Earth-type exoplanets orbiting in habitable zones very close to cool stars (M-dwarfs). Such exoplanets are exposed to extreme stellar winds and ultraviolet radiations. Exploring Mercury which is the innermost planet in the solar system plays a key role to understand such extreme environment.

The first Mercury orbiter MESSENGER explored this region and discovered a wide variety of phenomena. For example, Mercury’s magnetosphere is much more dynamic than one had predicted and substorm-like events with the time scale of minutes were observed. In addition, magnetic field measurements by MESSENGER suggests the existence of field aligned currents even though Mercury has no ionosphere. However, due to the highly ecliptic orbit with north-south asymmetry and limited capability for plasma measurements, many science topics still remain unsolved.

The next Mercury exploration mission BepiColombo, which is the international joint project between ESA and JAXA, will be launched in October 2018 and will arrive at Mercury in December 2025. The JAXA’s spacecraft for BepiColombo, Mercury Magnetospheric Orbiter (MMO), is spin-stabilized with a rotation rate of 15 rpm and is equipped to study the space environment of Mercury. MMO is mainly designed for plasma observations with the complete package of plasma instruments consortium and is expected to extract essential elements of space plasma physics that become visible in the Hermean environment. In addition, ESA’s Mercury Planetary Orbiter (MPO) also has several instruments for plasma measurements, so we can investigate Mercury’s environment with two points measurements.

Here we present how BepiColombo will contribute to deepen our understanding Mercury’s environment by addressing the puzzles raised by MESSENGER.

BepiColombo/MMO: The MMO spacecraft will have a ecliptic polar orbit with a period of 9.3 hours, a periapsis of 590 km, and a apoapsis of 11640 km. The orbital plane is same as that of MPO. The MMO will be spin-stabilized with a rotation rate of 15 rpm and a spin axis almost perpendicular to the orbital plane of Mercury around the Sun.

MMO has a complete package of plasma environment measurements: Magnetic Field measurement (MGF), Plasma Wave Instrument (PWI), and Mercury Plasma Particle Experiment (MPPE). These instrument will be operated as a plasma measurement consortium. In addition, two more instruments are installed onboard MMO to investigate Mercury’s exosphere and dust environment: Mercury Sodium Atmospheric Spectral Imager (MSASI) and Mercury Dust Monitor (MDM).

Almost all of tests in ESA’s test center (ESTEC) have successfully finished and soon the spacecraft will be shipped to the launch site in French Guiana. So now we can focus on science observation planning.

MMO has large constraints on science operations, such as thermal issue and limited telemetry rate. Due to the thermal issue each science instrument cannot always be turned on. In addition, due to the low telemetry rate in average, only a part (~20-30%) of science mission data with high resolution can be downlinked. Therefore, in order to maximize the scientific results and outcomes to be achieved by MMO, we are now working to optimize the science observation and downlink plans in detail.